EXAMINATION NO. 1

NAME_____SCORE_____/100

INSTRUCTIONS: This exam is closed book with one sheet of notes permitted. The exam consists of 4 questions for a total of 100 points. Please show your work leading to your answers so that maximum partial credit may be given where appropriate. Be sure to turn in your exam with the problems in numerical order, firmly attached together.

Problem 1 - (25 points)

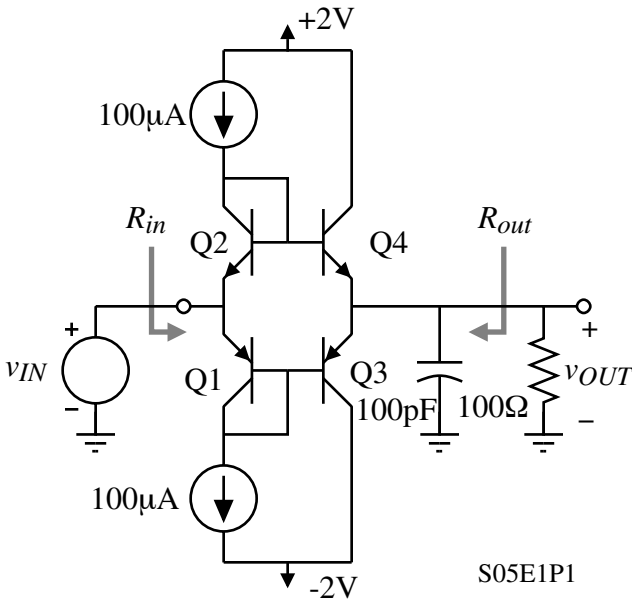
An emitter follower, push-pull output stage is shown. Assume that $\beta_N = \beta_P = 100$, $V_t = 25\text{mV}$, and $I_s = 10\text{fA}$.

a.) If the emitter areas of Q1 and Q2 are $10\mu\text{m}^2$, find the emitter area of Q3 and Q4 so that the collector current in Q3 and Q4 is 1mA when $v_{IN} = v_{OUT} = 0$.

b.) What is the ±peak output voltage of this amplifier? Assume the 100μA sources can have a minimum voltage across them of 0.2V.

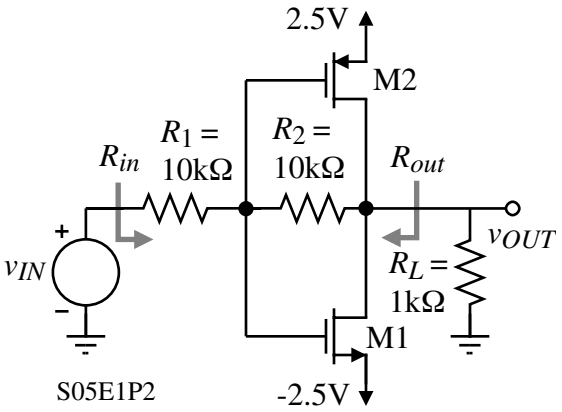
c.) What is the ±slew rate of this amplifier in V/μs?

d.) What is the small-signal input and output resistance of this amplifier when $v_{IN} = v_{OUT} = 0$? (Do not include the load resistance in the output resistance.)



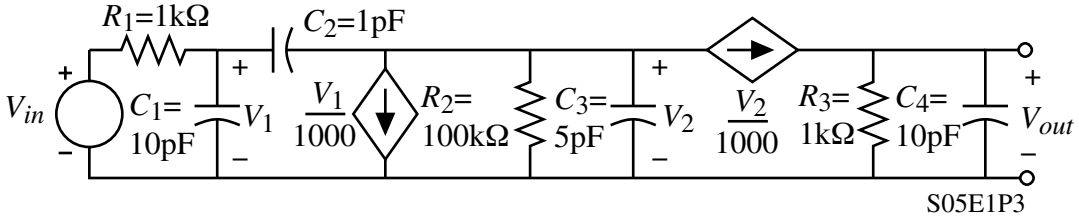
Problem 2 - (25 points)

Find the value for the small-signal output resistance R_{out} ignoring R_L and the value of the small-signal input resistance for the amplifier shown. Let the dc currents through M1 and M2 be 500μA, W_1/L_1 = 100μm/1μm and W_2/L_2 = 200μm/1μm. Assume the parameters of the NMOS transistors are K_N'=110V/μA^2, V_{TN} = 0.7V, and for the PMOS transistors are K_P'=50V/μA^2, V_{TP} = -0.7V. Ignore r_{ds1} and r_{ds2}.



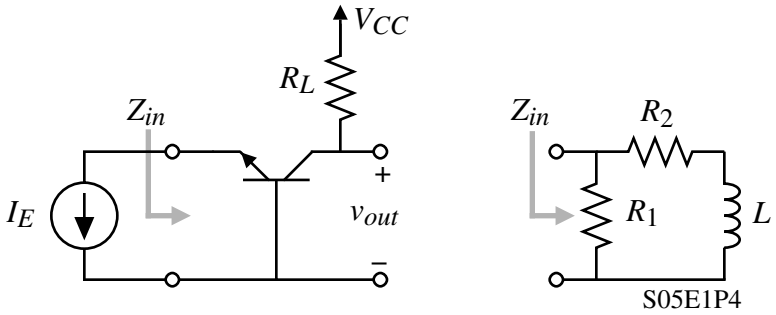
Problem 3 - (25 points)

Find the midband voltage gain and the –3dB frequency in Hertz for the circuit shown.



Problem 4 - (25 points)

On page 514 of the text, the statement is made that "the common base input impedance is low at low frequencies and becomes inductive at high frequencies"... Find the small-signal input impedance to the common base amplifier and express the values of the equivalent circuit, R_1, R_2, and L in terms of the parameters of the BJT small signal model (r_b, r_π, C_π, and β_o). Ignore r_o and assume that $R_1 > R_2$.



Extra Sheet